OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B751/01

PHYSICS B

Unit B751: Physics modules P1, P2, P3 (Foundation Tier)

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 15 minutes

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The number of marks for each question is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **28** pages. Any blank pages are indicated.

Examiner's Use Only:			
1		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	
8		16	
Total			

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

$$\text{efficiency} = \frac{\text{useful energy output } (\times 100\%)}{\text{total energy input}}$$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \tfrac{1}{2}\, mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

$$mgh = \tfrac{1}{2}\, mv^2$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \tfrac{1}{2}\, at^2$$

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

$$\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

$$I_e = I_b + I_c$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across seconday coil}} = \frac{\text{number of primary turns}}{\text{number of secondary turns}}$$

power loss = (current)^2 × resistance

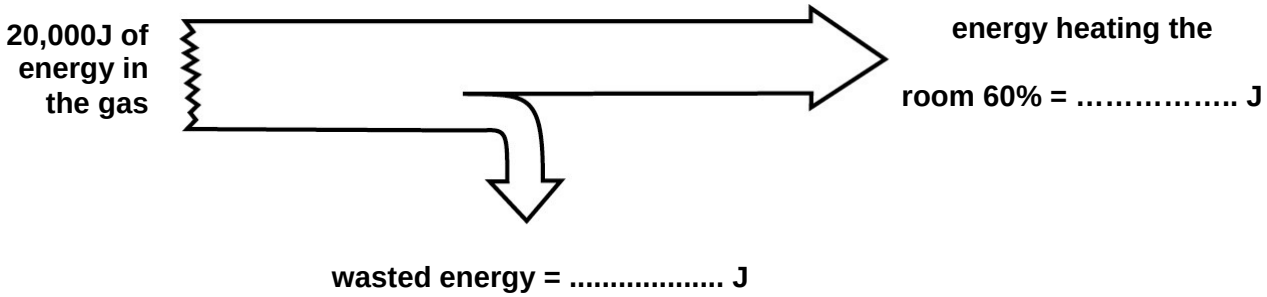
$$V_pI_p = V_sI_s$$

Answer **all** the questions.

Section A – Module P1

1 Asif has an old gas fire that heats the living room of his house.

(a) The diagram shows how much of the energy in the gas actually heats the room.



The total energy **input** is 20 000 J.

Complete the Sankey diagram.

[2]

(b) Asif changes his old gas fire for a new one because he thinks a more efficient fire will save him money.

Look at the data in the table about new gas fires.

model of gas fire	efficiency (%)	cost to buy gas fire in £	1 year saving on fuel costs compared to old gas fire in £
aspect	76	900	80
concept	74	600	70
firewell	70	750	50
moment	69	475	45
tinder	74	850	70

Asif plans to keep the new gas fire for **10 years**.

The salesman recommends that Asif buys the model with the highest efficiency.

Asif considers the payback time for each gas fire and the saving on fuel cost.

Which model of gas fire should Asif choose?

answer .....

Explain your answer.

.....

.....

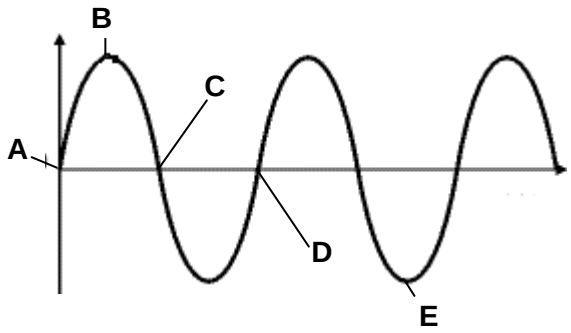
..... **[2]**

[Total: 4]

2 This question is about waves.

(a) A water wave is a transverse wave.

Look at the diagram of a transverse wave.



Use the letters on the diagram to identify the wavelength of this wave.

The **wavelength** is ..... **[1]**

(b) **(i)** The following measurements of some water waves on a lake were recorded.

4 waves pass a point in 2 seconds,

the wavelength = 1.25 m,

the depth of water is unknown.

Calculate the **speed** of this water wave.

.....

.....

answer ..... m/s. **[2]**

(ii) The **speed** of water waves **varies with the depth** of the lake.

Look at the information in the table.

It shows the speed of waves as they cross the lake.

depth of water in m	speed of wave in m/s
1.8	3.2
0.9	2.7
0.3	1.7

Use your answer from question (b) to estimate the depth of water in which the measurements were made.

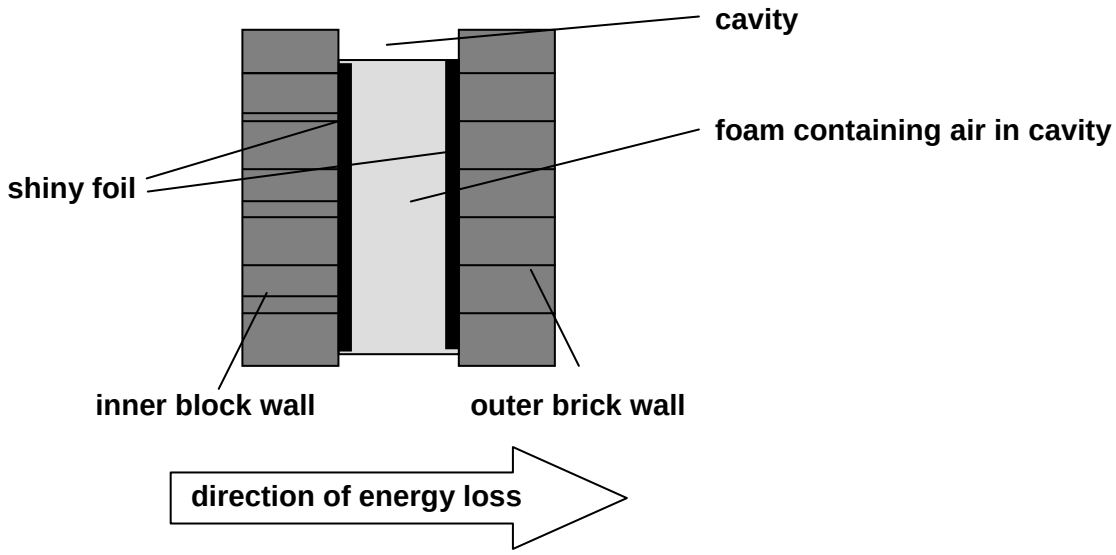
.....

..... **[1]**

[Total: 4]

3 Energy losses in the home can be reduced by energy saving measures.

One measure is to put foam covered with shiny foil as insulation in the cavity.



Describe how energy is lost through the wall from the inside to the outside **and** how the insulation reduces the different types of energy loss.

✎ *The quality of written communication will be assessed in your answer to this question*.

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..... **[6]**

[Total: 6]

4 This question is about radiation from the Sun.

Radiation is harmful.

One of the harmful effects of radiation is increased risk of cataracts.

Write about **one other** harmful effect of radiation from the Sun and **different** ways to reduce the risk of damage.

.....

.....

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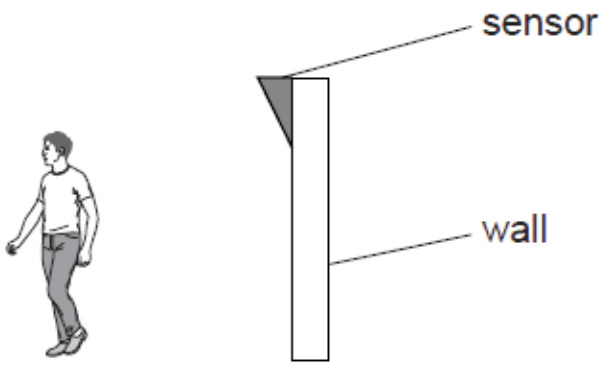
..... **[3]**

[Total: 3]

5 This question is about using waves and signals.

(a) Infrared sensors are used in burglar alarms.

Look at the diagram.



Why does this sensor detect a burglar but not a curtain moving in the wind?

.....

.....

..... **[2]**

(b) **(i)** Look at the digital signal.

Write the code for this signal in the boxes below.

[1]

(ii) Here is another signal.

How can you tell this is not a digital signal?

..... **[1]**

(c) Many years ago it was difficult to send messages long distances.

A runner had to carry a written message.

Technology has developed so that light can be used to send messages.

One example of such technology is optical fibres.

Describe one advantage and one disadvantage of using light to send messages.

.....

.....

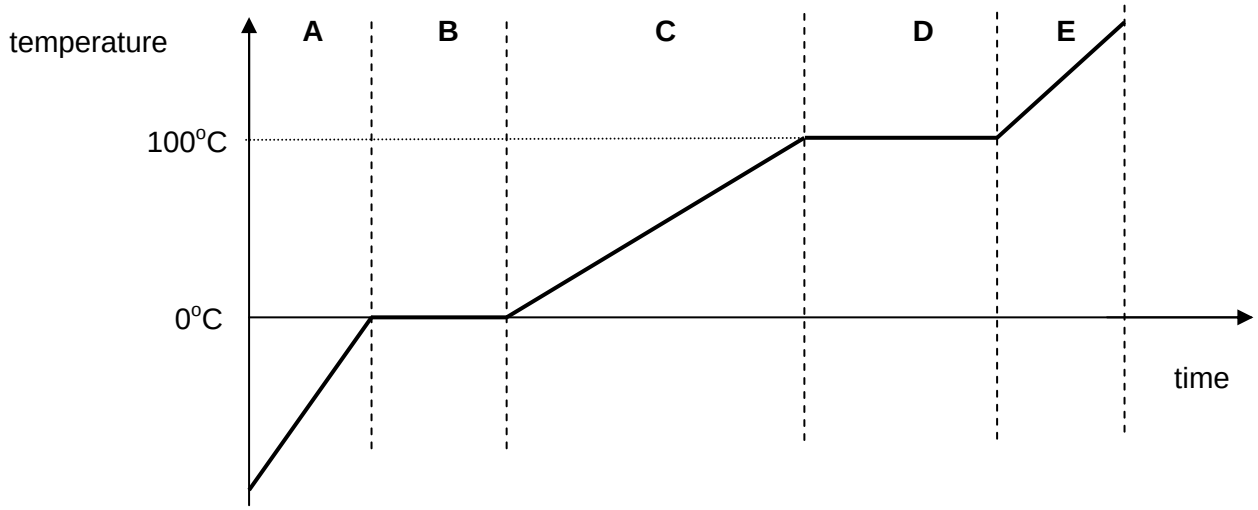
..... **[2]**

[Total: 6]

6 This question is about heating a solid.

The solid is warmed.

Look at the graph.



(a) Why does the temperature remain constant in part **B** of the graph?

.....

..... **[1]**

(b) Explain why the temperature goes up in part **E** after staying constant in part **D**.

.....

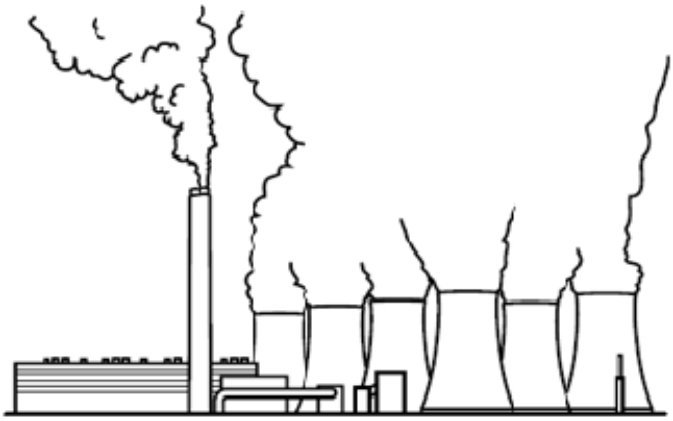
.....

..... **[1]**

[Total: 2]

Section B – Module P2

7 Electricity is produced by power stations.



(a) Describe the distribution of mains electricity.

.....

.....

..... **[2]**

(b) The **total input** for a power station is 6MW of power from the fuel.

The **useful output** is 2MW of electrical power.

Calculate the efficiency of the power station.

.....

.....

answer ..... **[2]**

(c) Look at the table. It gives information about the efficiency of different power stations.

type of power station	**efficiency (the longer the bar the more efficient)**
hydroelectric	**IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII**
tidal power	**IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII**
nuclear fission	**IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII**
wind turbine	**IIIIIIIIIIIIIIIIIIIIIIIIII**
geothermal	**IIIIIIIIIIII**
oceanic thermal conversion	**III**

(i) What can be concluded about tidal power stations from this table?

....

.... **[1]**

(ii) How could the presentation of this data be improved?

.... **[1]**

[Total: 6]

8 Distant galaxies can be observed from Earth using telescopes.

Mary is an astronomer.

She makes some observations of a distant galaxy. She finds it contains millions of stars.

She has found a dark region in the middle of several stars.

Mary makes a hypothesis that there must be a black hole in this darker region.

Other astronomers are not sure she is right.

What should Mary do to increase confidence in her hypothesis?

.....

.....

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.....

.....

..... **[3]**

[Total: 3]

9 Photocells can make use of energy from the Sun.

Look at the picture of a panel of photocells.

Joshua works as a park keeper in a very remote area.

He is keen to use photocells for all of the energy needs of the park.

Discuss if this is a good idea or not.

In your answer suggest arguments for **and** arguments against using only photocells in the park.

✎ *The quality of written communication will be assessed in your answer to this question*.

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..... **[6]**

[Total: 6]

10 This question is about using electrical appliances.

Look at the information about some electrical appliances.

appliance	power rating in kilowatts	time used each week in hours
CD player	0.01	5
computer	0.18	10
dishwasher	1.20	2
garage door opener	0.35	0
popcorn maker	0.25	1
satellite dish	0.01	168
vacuum cleaner	0.60	1
washing machine	0.50	8
iron		4

(a) The iron is connected to the 230 V mains.

3.5 A flows through the circuit.

Calculate the power rating of the iron in kilowatts.

Copy your answer into the table.

.....

.....

answer ..... kilowatts **[2]**

(b) Alan needs to save some money on his electricity bills.

Use the information in the table to identify which appliance **costs the most** to run each week **and** explain why.

.....

.....

..... **[2]**

(c) Alan prepares for a power cut. He supplies his family with battery-powered torches.

(i) Name the type of current supplied by a battery.

..... **[1]**

(ii) Write down **one difference** between the power supplied by a battery and the power supplied by the National Grid.

.....

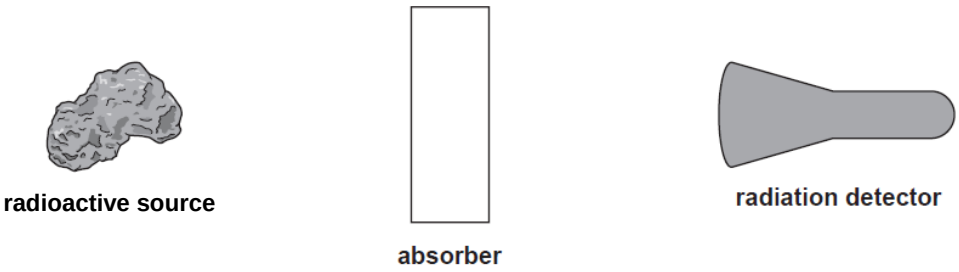
..... **[1]**

[Total: 6]

11 This question is about radioactivity.

Claire investigates the relative penetrating power of different types of radiation.

Here is a diagram of her apparatus.



(a) Claire is considering using nuclear radiation emitters as tracers **inside** the human body.

A radiation detector would detect the nuclear radiation outside the patient's body.

Look at the table.

type of emitter	typical range in air in cm	typical range in soft body tissue in cm
alpha	3.7	0.0005
beta	90	1.2
gamma	70000	100

Claire decided that alpha emitters should not be used as tracers in the human body.

Use the information in the table to suggest why.

.....

.....

..... **[2]**

(b) Claire uses radioactive materials for her investigation.

This can be dangerous.

What **precautions** should she take when handling radioactive materials?

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..... **[2]**

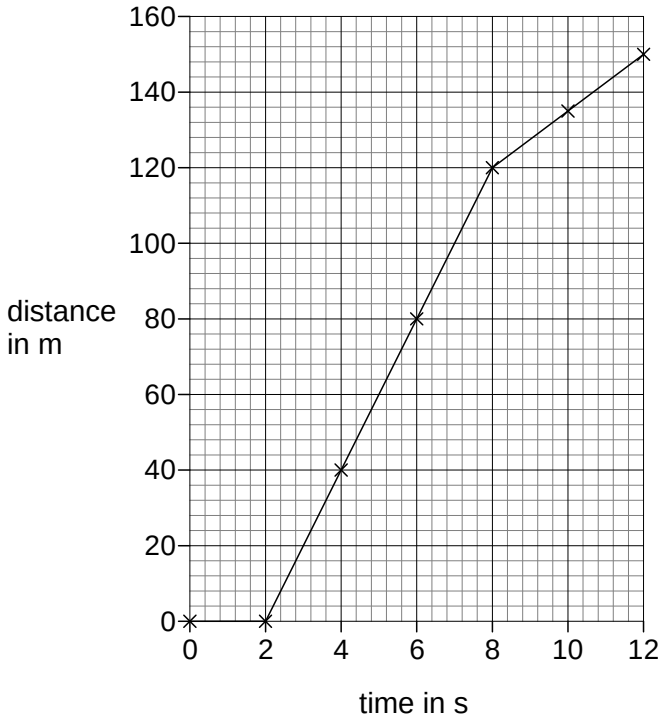
[Total: 4]

Section C – Module P3

12 This question is about motion and speed.

Brian drives 150m.

Look at the graph of Brian's journey.



(a) Describe what the graph shows about Brian's journey.

.....

.....

.....

.....

..... **[3]**

(b) The speed limit is 13 m/s.

(i) An average speed camera took a photograph at 0 seconds and at 12 seconds.

Would the average speed camera have found Brian to be speeding? Use calculations to support your answer.

.....

.....

..... **[1]**

(ii) Did Brian break the speed limit at any point in his journey? Use evidence from the graph to support your answer.

.....

..... **[1]**

(c) Brian drove the same journey again at half the average speed.

How will this affect the time it takes for him to drive 150 m?

.....

..... **[1]**

[Total: 6]

13 (a) This question is about cars **accelerating**.

(i) Pat measures the speeds of two cars.

Both cars start from rest.

The diagram shows the speed changes of the cars after **3 seconds**.

car **A**

speed change of car A = 10 m/s

car **B**

speed change of car B = 15 m/s

Calculate the acceleration of **car A**.

.....

.....

.....

answer ..... units ..... **[2]**

(ii) **Car B** has a greater acceleration.

Explain how you know this without calculating acceleration.

.....

..... **[1]**

(b) The driver of **car B** has to stop her car quickly.

The total distance the car travels before it stops is the **stopping distance**.

Name the two parts which make up the stopping distance and explain why it is important to know the stopping distance of a car.

.....

.....

.....

..... **[2]**

[Total: 5]

14 This question is about fuel consumption for a lorry.

(a) Look at the information about fuel consumption for this lorry in different driving conditions.

driving condition	windows of lorry	deflector fitted on lorry	fuel consumption in four tests in kilometres per litre	mean fuel consumption in kilometres per litre
A	closed	no	6.6, 6.8, 6.5, 6.5	6.6
B	closed	yes	7.6, 6.9, 7.0, 7.3	7.2
C	open	no	5.0, 6.0, 5.5, 5.9	5.6
D	open	yes	7.2, 7.0, 6.7, 6.7	

Calculate the **mean** fuel consumption for driving condition **D**.

Write your answer in the table.

.....

..... **[1]**

(b) Which driving condition gives the best fuel consumption?

Use the information in the table to explain why.

.....

..... **[1]**

(c) Car manufacturers are required to publish environmental and running cost data about the cars they manufacture. This is to help car buyers choose which car to buy.

car	fuel consumption in kilometres per litre	engine size (capacity) in cc	fuel costs in £ per 20 000 kilometres	CO_2 emissions in grams/kilometre	noise levels in dB
V	23.5	999	1103	122	73.0
W	20.4	1149	1273	138	72.4
X	18.2	1498	1428	158	72.0
Y	17.1	1598	1516	165	73.7
Z	16.7	1390	1559	172	70.0

Ronan and Anna want to buy a new car.

They want a car which provides the best balance between economic and environmental impact.

Ronan says 'We should buy car **Z**, because this car has the lowest fuel consumption and is the quietest model'. Anna realises that Ronan is wrong.

Use the data in the table to explain why Ronan is wrong. Which car should Anna and Ronan choose? Give the reasons for your choice.

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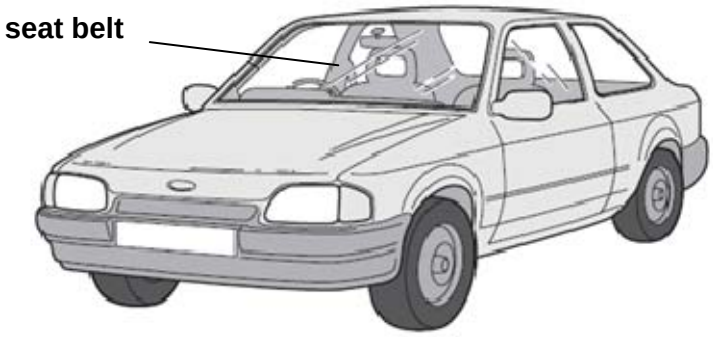
..... **[3]**

[Total: 5]

15 This question is about car safety.

Modern cars have **many** safety features.

Look at the diagram.



Some safety features **prevent** accidents and some **protect** the driver.

Seat belts are an important safety feature.

Explain how they work and why they have to be replaced after a crash.

✎ *The quality of written communication will be assessed in your answer to this question*.

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..... **[6]**

[Total: 6]

16 Britney is a skydiver.

She jumps out of a plane.

(a) After 10 seconds, Britney is falling at a steady speed.

What is the name of this steady speed?

..... **[1]**

(b) Explain how Britney reaches this steady speed.

.....

.....

..... **[2]**

[Total: 3]

Paper Total [75]

END OF QUESTION PAPER

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OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B751/01

PHYSICS B

Unit B751: Physics modules P1, P2, P3 (Foundation Tier)

MARK SCHEME

Duration: 1 hour 15 minutes

MAXIMUM MARK 75

This document consists of 16 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.

2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).

4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant – applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   eg mark scheme shows 'work done in lifting/(change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.

6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Question			Expected answers	Marks	Additional guidance
1	(a)		12 000 J heating the room(1) 8 000 J wasted (1)	2	 **allow** ecf for wasted energy if wasted + heating add up to 20 000 J
	(b)		concept (no mark) because Concept is the only model where payback time is less than 10 years and this means that Asif saves most money (£100) over 10 years with the Concept (2) **OR** because Concept is the only model where payback time is less than 10 years / over 10 years Asif saves the most money with the Concept (1)	2	concept not chosen or incorrect model chosen answer scores (0) **allow** correct use of figures eg paid £600 and get £700 back in savings at the end of 10 years (1) **allow** although Aspect is more efficient / saves more on fuel each year, Aspect costs more than the Concept (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
2	(a)		idea of distance between **A** and **D** (1)	1	**both** letters needed (either order)
	(b)	(i)	2.5 (m/s) (2) **but if answer is incorrect** 2 X 1.25 (1)	2	
		(ii)	estimated depth of water within the range of 0.3 – 0.9 (m) (1)	1	**allow** ecf from part (b)
			Total	**4**	

Question	Expected answers	Marks	Additional guidance
3	**Level 3** A detailed description of the three processes by which energy is transferred from inside to outside and how energy losses are reduced using cavity wall insulation. Applies knowledge of how inclusion of shiny foil reduces energy loss in the context of a cavity wall. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Limited description of some processes by which energy is transferred, order from inside to outside may be confused, some reductions by cavity walls described but not linked to different forms of transfer. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** An incomplete description, naming some processes by which energy is transferred. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • cavity wall insulation slows down the process of heat transfer • cavity wall insulation retains more heat inside the home • energy moves by **conduction** through the internal blocks • foam or air is a poor **conductor** / foam or air is a good **insulator** so energy transfer is reduced • air/bubbles trapped (in foam) reduces **convection** • reduces heat or energy **radiated** into cavity • inner silver foil surface reflects heat or IR back • outer silver foil surface emits less heat • energy moves by conduction through the external bricks **accept** cavity wall insulation reduces energy losses mainly by conduction and convection **ignore** heat escapes **reject** heat particles
	Total	**6**	

Question			Expected answers	Marks	Additional guidance
4			sunburn/skin cancer/premature skin aging (1) spend less time in the sunshine (1) <u>use a higher factor</u> sun cream / block (1)	3	**allow** excessive sun tan (1) **allow** put on a hat / sit in the shade (1)
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
5	(a)		infrared sensors are sensitive to heat, and can detect objects that are warmer than their surroundings(1) the burglar gives out body heat and so is warmer than the surroundings, and the curtain is not (1)	2	marking points in either order can gain credit 'infrared sensors detect body heat' alone is worth 1 mark **ignore** the curtain is not hot
	(b)	(i)	correct table 0 1 0 1 0 1 1 1 0 0 (1)	1	
		(ii)	it has continuously varying values (1)	1	**allow** it is not only on or off / it is not only 0 or 1
	(c)		advantage: increased speed of communication compared to runner / digital signal used so easier to remove interference (1) disadvantage: idea of need for a code / need for technology to support use of light (at transmitter and receiver) (1)	2	**allow** faster / quicker communication (1) **allow** higher level answers above target grade eg allows use of multiplexing (1)
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
6	(a)		because the solid is melting (1)	1	**allow** higher level answers above the target grade eg energy supplied is used to break bonds between molecules (1) **ignore** changing state
	(b)		because the gas (made during boiling) is heating up / liquid has all boiled in part **D** or previous part of graph (1)	1	
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
7	(a)		mains electricity is distributed from power station to consumers (1) via **national grid /** via a **network** of power cables on pylons (1)	2	**allow** example of consumer types – homes, factories, businesses etc.
	(b)		0.33 or 33% (2) **but if answer incorrect** 2/6 (1)	2	**allow** 1/3 (2) correct substitution into correct equation will score (1) if answer is incorrect **allow** correct number with incorrect unit eg 33MW/0.33MJ (1)
	(c)	(i)	(chart shows) tidal power is (slightly) less efficient than hydroelectric and is (a lot) more efficient than nuclear / wind / geothermal / oceanic thermal conversion (1)	1	
		(ii)	needs a scale / need to show efficiency as a ratio / percentage / displayed as a bar chart with figures on it (1)	1	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
8			she should make predictions based on her hypothesis (1) then she should test her predictions / gather more data / gather more evidence (1) compare this new data to her original prediction (1)	3	**marking points must be in correct order to gain full credit for this question** **allow** idea of using a more accurate telescope (1) **allow** examples of the type of evidence she should gather eg to show the effects of a black hole (1) **allow** (conclusion) not been peer reviewed/checked by other scientists (1) as alternative to any of the marking points
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
9			**Level 3** A balanced answer, including arguments for **and** against using photocells, arguments are developed to explain their relevance and linked to the context in the question. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Answer includes arguments for **and** against using photocells; arguments are limited in detail and relevance not fully explained. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** Answer includes arguments for **or** against using photocells, arguments are simplistic. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** **arguments for** • light energy from the Sun is transferred into electricity • able to produce direct current (DC) • can operate in remote locations like a park • low maintenance • no need for power cables • no need for fuel • long life • renewable energy source • no polluting waste • not dependent on National Grid for electricity • can generate surplus electricity to sell to electricity companies **arguments against** • amount of sunlight that arrives at the surface on Earth is not constant • amount of light available depends on location, idea that could be covered by trees in a park • amount of light available depends on time of day • amount of light available depends on weather conditions • as the Sun does not deliver that much energy to any one place at any one time, a large surface area is required to collect the energy at a useful rate. **example of simplistic approach:** • amount of light available depends on time of day **example of developed approach:** • amount of electricity produced depends on the amount of light available so no electricity is produced at night (when it is dark)
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
10	(a)		0.805 (kilowatts) (2) **but if answer incorrect** 230 x 3.5/1000 (1)	2	**allow** 0.8/0.81 (kilowatts) (2) **allow** answer in table or on answer line
	(b)		**appliance that costs most to run** washing machine (1) **because** **any one from** 0.5 x 8 = 4 (kilowatt hours) which is the highest value (1) cost depends on power rating and time switched on and the washing machine is on for a long time with (quite a) high power (1)	2	**allow** formula cost = time x power (x cost per kilowatt hour) (1)
	(c)	(i)	DC / direct current (1)	1	
		(ii)	National Grid supplies AC (battery supplies DC)/AW (1) National Grid has a higher voltage/ora (1)	1	**allow** higher level descriptions of how power is generated eg National Grid uses power from a generator and battery does not (1)
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
11	(a)		alpha would not be able to penetrate the skin and so would not reach a detector outside the body (2) **OR** alpha would not be able to penetrate the skin / alpha would not reach the detector (1)	2	answers must link penetration of alpha to reaching detector outside the body to gain 2 marks
	(b)		wear protective clothing (1) use tongs / keep her distance (1) short exposure time (1) shielded / labelled storage (1)	2	**allow** lead shield / lined apron (1) **ignore** lab coat / goggles
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
12	**(a)**		straight horizontal line / between 0 and 2 seconds shows: zero speed / not moving / stationary (1) straight line gradient / between 2 and 8 seconds shows: steady speed (1) less steep gradient / between 8 and 12 seconds shows: slower steady speed / ora (1)	3	**allow** standing still (1) **allow** Brian does not move for 2 seconds, then drives fast for 6 seconds, and drives slower for 4 seconds. (2) as no reference to steady speed
	(b)	**(i)**	no because average speed is 12.5 m/s (1)	1	**mark is for evidence of calculation to support answer**, not simply for stating 'no'
		(ii)	yes (no mark) because he was stationary for some of the time so for other times he was going faster than his average speed / idea that gradient changed so at some points in journey he was going faster than the average speed (1)	1	**allow** higher level answers above target grade where speed is calculated for part of the journey
	(c)		the time taken to travel the journey will be double (1)	1	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
13	(a)	(i)	3.33 or 3 1/3 (1) m/s^2 (1)	2	**ignore** more than 2 decimal places **allow** 3.3
		(ii)	idea of greater speed change (in same time / 3 seconds) (1)	1	
	(b)		thinking distance + braking distance (1) to know how much distance to leave between cars / to avoid a crash when braking (1)	2	**allow** description of the two distances (eg thinking distance = distance travelled whilst reacting/before putting brakes on) but **both** needed (1) **allow** for road safety (1)
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
14	**(a)**		6.9 (kilometres per litre) (1)	1	**allow** answer in table or on answer line
	(b)		driving condition **B** gives the best fuel consumption because it has the best shape/ is more aerodynamic/is streamlined (1)	1	**allow** driving condition **B** gives the best fuel consumption as windows closed and deflector fitted (1)
	(c)		Ronan has got fuel consumption back to front – more km per litre is better / AW (1) **no mark for choice of car, marks are for valid reasons** most economical/lowest economic impact is vehicle **V** OR best fuel consumption/lowest cost for fuel is car **V** (1) environmental impact is a choice between **Z** quietest and **V** lowest CO_2 emissions (1)	3	**allow** idea that car **Z** will go the shortest distance on a set amount of fuel (1) **answers must support choice of car to gain credit**
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
15			**Level 3** Detailed explanation of reasons for fitting seat belts and replacing them after crashes including application of energy and detail of damage to seat belts. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Limited explanation of reasons for fitting seatbelts and replacing them after crashes including some reference to the type of damage to the seat belt. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** An attempted explanation of reasons for fitting seatbelts and replacing them after crashes; references do not go beyond the idea of protecting the driver OR that the seat belt is damaged. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** **how seat belts work** • seat belts are intended to protect all the passengers wearing them in the event of an accident • by absorbing energy when vehicles stop • by reducing the force on the wearer • because the momentum change is spread over a longer time • reducing injuries for wearers **accept** examples of how seat belts protect, eg seat belts keep you in your seat/stop you hitting the windscreen **why they have to be replaced** • seat belts are damaged in a crash • as energy is absorbed seatbelt (deforms) changes in shape • some damage to seat belts is irreversible • idea of 'one time use' / repeated damage could cause seatbelt to break / seatbelt won't be as strong after an accident • damage to anchor points, belt locking mechanism etc, • damage may not be easily visible, so replace to minimise future risk **accept** examples of specific damage eg seat belts lock in a crash **accept higher level answers** eg seat belts spread the stopping force across ribs and pelvis/stronger parts of body seat belt webbing is a flexible material
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
16	**(a)**		terminal (speed) (1)	1	**allow** terminal (velocity)
	(b)		initially Britney's speed increases and frictional forces increase with speed (1) when the forces are balanced, her speed is steady / does not change (1)	2	**allow** answers in terms of acceleration **allow** alternative terms for frictional forces (drag, friction, air resistance) for second marking point candidates must link balanced forces to steady speed **ignore** up thrust
			Total	**3**	

Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)		2		**2**
1(b)			2	**2**
2(a)	1			**1**
2(b)(i)	1	1		**2**
2(b)(ii)		1		**1**
3 ✎	4	2		**6**
4	3			**3**
5(a)	1	1		**2**
5(b)(i)		1		**1**
5(b)(ii)		1		**1**
5(c)	1	1		**2**
6(a)		1		**1**
6(b)		1		**1**
7(a)	2			**2**
7(b)	1	1		**2**
7(c)(i)			1	**1**
7(c)(ii)			1	**1**
8		3		**3**
9 ✎	3	3		**6**
10(a)	1	1		**2**
10(b)		2		**2**
10(c)(i)	1			**1**
10(c)(ii)	1			**1**
11(a)		2		**2**
11(b)	2			**2**
12(a)	1	2		**3**
12(b)(i)		1		**1**
12(b)(ii)		1		**1**
12(c)		1		**1**
13(a)(i)	1	1		**2**
13(a)(ii)		1		**1**
13(b)	2			**2**
14(a)		1		**1**
14(b)		1		**1**
14(c)		1	2	**3**
15 ✎	5	1		**6**
16(a)	1			**1**
16(b)	2			**2**
	34	**35**	**6**	**75**